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Abstract

In recent years, organizations have started formally assigning technical professionals to fill the role of technological gatekeepers. In this study we examine the effectiveness of such nominated boundary spanners in transferring technologies from the R&D center of a large organization to its operating units. We find that more than half the designated liaison agents do not function as gatekeepers because they lack either the internal or external communication networks that are critical for being effective in that role.

Introduction

Numerous researchers have pointed out that the process of technology transfer can be facilitated by the presence of special liaison agents, operating either individually or as part of a group, who span the boundary between different organizational units. Quinn and Mueller (1963) have identified task-force groups, corporate development units, staff groups at corporate level, research groups with special budgets, and individual researchers who champion their ideas as some examples of organizational mechanisms that various companies have used for this purpose.

Other descriptions and classifications for this coordinating role also exist, but the underlying idea is generally the same: there is a need to integrate the values, roles, and perspectives of different functional divisions through some formal mechanism to resolve differences and conflicts between them. According to Roberts and Frohman (1978), "when a research result is to be transferred, movement of research personnel is a key factor in the project's survival through the torturous journey toward manufacturing or the market."

Allen (1977) has identified the boundary spanning role of the technological gatekeeper in the context of R&D and other technical functions. The gatekeeper is a high technical performer who connects an organization with outside sources of technology. He keeps up with technical developments outside the organization by reading the more professional literature and by communicating with external technical experts. Further, because of his proven technical competence he is frequently consulted on technical matters. As a result, the gatekeeper acts as a very effective channel for transferring technical information across organizational boundaries. Though the gatekeeper phenomenon was initially identified by Allen in the context of R&D project groups, the role definition in terms of information transfer has been extended and analyzed in other contexts also (Roberts, 1978).

In recent years there has been a trend in technical organizations towards formalizing the role of the gatekeeper. In this study we examine

whether people in such formally designated boundary spanning roles effectively fulfill their charter. Data for the study were gathered from five geographically separate operating divisions of a large company in the energy resources industry. The company's Corporate Research Center (CRC) is responsible for developing and disseminating new exploration technologies to these operating units. To facilitate this transfer process at the operations level, each of the divisions has a formally designated Technology Resource Group (TRG) whose members are charged with two tasks: 1) to act as internal consultants in solving technical problems and providing technical information, and 2) to act as a liaison with the CRC by learning about technologies developed there and promoting their use by the divisional professionals.

The members of the TRG are the focus of our attention in their role as nominated boundary spanners. In this paper we identify the gatekeepers in the divisions and examine the degree of overlap between TRG membership and technical gatekeeping. We also discuss the factors that prevent or facilitate the emergence of nominated liaison agents as effective gatekeepers.

Profile of Technical Resource Group Members

Thirty-two technical professionals in the divisions (out of a total of 282) are members of the Technology Resource Group. Since they are charged with the task of communicating with the CRC and promoting new technologies developed there among other divisional professionals, it is important to see if they are successful in this liaison role. We will approach this issue from a number of angles, each touching on a different aspect of the boundary spanning function.

1. Communication with the CRC: We would expect members of the TRG to communicate more with the CRC than do other divisional professionals. This is borne out by the data. TRG members had, on average, 1.7 communication partners at the CRC during the last year, compared to the mean of 0.7 contacts for non-members. This difference is statistically significant ($p<0.001$). Further, 69 percent of them had at

least one contact with the CRC in the last year, as compared to 32 percent for the rest of the sample ($p<0.001$).

2. Visits to the CRC: The coordinating role would call for more interaction with the CRC, which should result in TRG members making more visits to the CRC than other divisional professionals. The mean number of visits reported by TRG members is 2.5, almost double the mean of 1.3 for non-members ($p=0.002$). However, the proportion of TRG members who had visited the CRC (69%) is not significantly different from the proportion for non-members (60%), indicating that those who are not members of the TRG as just as likely to have visited the CRC, but that the TRG members do so more frequently.

3. Exposure to Orientation Programs: The CRC runs orientation programs to acquaint divisional professionals with new CRC developed technologies that would be relevant to their work. 34 percent of TRG members had attended the orientation sessions at the CRC, whereas the proportion for non-members was 35 percent.

4. Adoption of Technologies: The mean number of new technologies from the CRC adopted by TRG staff over the last three years is 1.6 whereas the mean for other divisional professionals is 0.7 ($p<0.001$), indicating that the special nature of their task does lead TRG members to adopt a greater number of new technologies. Further, almost twice as many of them (72%) adopt new technologies as compared to non-members (37%).

5. Contacts with other divisional professionals: We would expect (as did the organization) TRG members to have more communication partners within their divisions. This is not borne out by the data. The mean number of people with whom a TRG member communicated over the previous year is 3.3. This is not significantly different from the mean for other divisional professionals, which is 3.1.

6. Attitudes regarding the CRC: Because of their greater exposure to the CRC, one might expect TRG members to hold attitudes towards the

CRC that are based on more first-hand experience as compared to other divisional employees. Scores on the three perception factors determined through an attitude survey show that the attitudes of Technology Resource Group members are significantly more favorable than those of other professionals with regard to the perceptions of ***relevance*** of CRC projects and ***approachability*** of researchers (Table I). On the perception of CRC's ***user-orientation*** with reference to the divisional professionals, TRG members did not differ significantly from their colleagues.

Table I

Attitudes of Members of the Technical Resource Group about the Corporate Research Center

Mean Factor Score	Members of TRG (N=30)	Non-members (n=230)	p*
attitude about relevance and utility	0.68	-0.09	0.001
attitude about approachability of researchers	0.54	-0.07	0.002
attitude about the user-orientation of researchers	0.36	-0.05	0.06

* Mann-Whitney U tests

7. Readership of journals: There are four major journals that are important sources of technical information for the professionals in our study. In Table II we summarize the data on readership of these journals. The first one, called Geophysics, is the most technically demanding journal, followed by Geophysical Prospecting in terms of technical

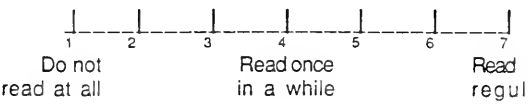
sophistication and difficulty of comprehension, as judged by experts in these fields. The other two journals are more in the nature of trade magazines and are judged as easy to read and understand. From Table II we note that TRG members rank higher in readership of the technically demanding journals, while non-members reported more regular readership of the trade journals.

Table II

Journal Readership by Members of the Technical Resource Group

Journal	Readership* Members of TRG (N=31)	Non-members (n=248)	p**
Geophysics	5.1	4.3	0.004
Geophysical Prospecting	3.1	2.3	0.02
Oil and Gas Journal	3.5	4.5	0.008
The Leading Edge	3.9	4.1	N.S.

* According to the following scale:



** Mann-Whitney U tests

From the above profile descriptions, it is clear that TRG members are better connected with the CRC and the hard technical literature. They also personally adopt more new technologies from the CRC than other divisional professionals. It appears therefore that they are in a position to influence the adoption of new technologies by other divisional

employees. If this potential is realized in practice, we would expect respondents who have consulted with TRG members to have adopted more new technologies than those who did not have any interactions with them. A test of this hypothesis shows that the adoption behavior is not significantly affected by communicating with TRG consultants (Table III).

Table III

Association between Contacts with TRG members and Technology Adoption

	Respondents not in TRG who have no links with TRG Members (n=153)	Respondents not in TRG who have at least one link with TRG (n=95)	p
Proportion who have adopted at least one technology from the Corporate Research Center in the last three years	34%	39%	N.S.*
Mean number of technologies adopted	0.66	0.75	N.S.**

* Chi-square test

** Mann-Whitney U tests

A plausible explanation for this is that those who consult with TRG members seek their help only for narrow problem solving needs, so that the interaction does not result in any actual transfer of new technologies. It is also likely that though the TRG members taken as a group have more links with the CRC and adopt more technologies on average, there might be individual differences in their gatekeeping effectiveness which might cancel out at the aggregate level. To probe this matter we now turn to an

analysis of the true gatekeepers (those with both high external and high internal communication) in the divisions, with particular emphasis on the gatekeeping role of the TRG staff.

Gatekeepers in the Divisions

The defining characteristics of a gatekeeper are generally specified along two dimensions (Allen, 1977):

- the gatekeeper is an 'external communication star', i.e. he is connected substantially more than his colleagues with sources of technical information outside the organization

- he is a top technical performer who is frequently consulted by organizational colleagues on technical matters. This internal consultant role results in the gatekeeper developing more communication links with his organizational colleagues than non-gatekeepers. This characteristic is generally described as that of being an 'internal communication star'.

Therefore, the gatekeeping role involves two functions -- a communication function and a technical consulting function. It is the combination of these in one person that makes the gatekeeper such an effective channel for transferring technology.

There is a certain arbitrariness in deciding whether an individual is an internal or external communication star because there is no one right way to determine a cut-off point such that people below that point are not communication stars, whereas those above it are. In practice, the gatekeeper role is often operationalized by specifying a cut-off point of one standard deviation above the mean on all the relevant measures.

Another important issue for identifying gatekeepers is the frame of reference: should a person be classified on the basis of the communication behavior he himself reports, or should his role as described by other people be the basis for deciding whether he is a gatekeeper? We

distinguish between gatekeepers identified under these different methods by referring to them as self-reported and nominated gatekeepers, respectively. Self-reported measures may be subject to a number of sources of bias and error -- respondents may provide a long list of communication partners if they suspect that the survey is aimed at identifying gatekeepers; further, some respondents may not report the names of all the people with whom they communicate, though they may in fact have substantial links within or outside the organization.

On the contrary, if a particular person is consistently named as a communication partner by people in the division as well as at the CRC, then we can be more confident that this nominated gatekeeper does in fact effectively fill the gatekeeper role. Therefore we shall primarily use this criterion for examining the gatekeeping role of TRG members.

Based on these considerations, the following procedure was used to identify the divisional gatekeepers. A questionnaire was filled out by divisional professionals in which they listed the names of others in their division with whom they communicated at least a few times per year. For each division, a master list of all the names mentioned by all the respondents was compiled. For each of these names, a count was made of the number of respondents who had mentioned it. The mean for these frequencies was computed for each division. Those people whose frequency was one standard deviation above the mean for that division were designated as internal communication stars. Similar questionnaires were administered at the the CRC and processed in a similar fashion. Researchers' contacts in the divisions were tabulated and those who were mentioned with a frequency one standard deviation above the mean were designated as external communication stars. The cut-off points were almost identical for all of the five divisions (Table IV). Individuals whose names appeared on the lists as both internal and external communication stars were designated as gatekeepers.

Table IV

Criteria for Identifying Regional Gatekeepers

	Number of nominated contacts with divisional colleagues to be an Internal Commn. Star	Number of nominated contacts with Corporate Research Center to be an External Commn. Star
Domestic Region A	6	2
Domestic Region B	6	2
Domestic Region C	6	2
International Region A	5	2
International Region B	5	2

A total of 19 gatekeepers were identified in all the divisions taken together (Table V). Out of these 19, 15 were TRG members. Thus we find that 78 percent of the gatekeepers are members of the formally designated liaison groups in the divisions. However, looking at the total membership of the TRG, we note that only 38 percent of its 39 members emerge as gatekeepers. This partly explains our finding that contacts with TRG members is not associated with a significant increase in the number of technologies adopted by non-members.

Table V

Distribution of Gatekeepers and TRG Members in the Regions

Region	Number of Gate-keepers	Number of TRG Members	Number of Gatekeepers not in TRG	Number of TRG Members who are also Gatekeepers
Domestic Region A	4	8	1	3
Domestic Region B	3	6	1	2
Domestic Region C	4	9	0	4
International Region A	2	10	0	2
International Region B	6	6	2	4
All Regions Combined	19	39	4	15

To find out why 24 TRG members do not emerge as gatekeepers, we next examine the communication data for them. Two of them qualify as external communication stars, but lack the internal consulting relationships needed to be gatekeepers in their division. Another six are connected well with their divisional colleagues, but fail to become gatekeepers because they lack the required linkages with the CRC. The remaining sixteen are neither internal or external communication stars. We may conclude from this analysis that the gatekeeping function of the TRG is substantially unrealized in the organization under study.

So far we have examined the overlap between gatekeeping and TRG membership on the basis of nominated data. Self-reported communication data also indicate that the overlap is rather weak. Of the 32 respondents who were TRG members, only two could be described as gatekeepers on the

basis of the internal and external links that they themselves reported. Only seven are internal communication stars. This proportion of 22 percent is almost identical with the proportion of non-TRG members who are internal communication stars according to self-reported data. However, 13 TRG members were external communication stars and this proportion of 41 percent of their total is significantly higher than the 17 percent prevailing for the rest of the divisional professionals (Chi-square = 9.8, $p < 0.002$).

The data also show that there are four self-reported gatekeepers who are not members of the Technical Resource Group. In addition to these four, there are many other non-members who are well connected either with their divisional colleagues or with the CRC. There are 56 such professionals who are internal communication stars and 43 who are external communication stars. This underscores the need for managers in the divisions to develop the gatekeeping potential of these individuals by helping them to develop the missing internal or external linkages.

Influence of CRC Experience on Communication and Technology Adoption

Roberts and Frohman (1978) and Cohen, et al (1979) have pointed out the value of personnel transfer from research to operating units to move technologies downstream in the organization. In this section we examine the data to see if divisional professionals who had worked previously at the company's CRC exhibit significantly better communication and adoption behavior as compared to other respondents.

There were 17 divisional scientists who had worked at the CRC before they started work in the divisions. The communication and adoption data for these ex-researchers is compared with the rest of the divisional personnel (Table VI). As would be expected because of their prior experience, the ex-researchers had almost three times as many contacts with the CRC as their colleagues without such experience. They also reported having adopted almost twice as many technologies as the rest of the respondents.

Table VI

Communication and Technology Adoption by Regional Professionals with Corporate Research Center Experience

	Regional Professionals who have worked at the Corporate Research Center (n=17)	Regional Professionals who have not worked at the Corporate Research Center (n=265)	p
Proportion who have at least one link with researchers	65%	33%	0.01*
Mean number of links with researchers	2.0	0.7	0.002**
Proportion who have adopted at least one technology from the Research Center in the last three years	76%	39%	0.002*
Mean number of technologies adopted in the last three years	1.6	0.9	0.004**

* Chi-square test

** Mann-Whitney U tests

We next examine if ex-researchers are better coupled with the CRC and with divisional colleagues as compared to TRG members who have not worked at CRC. We note that ex-researchers who are not in the TRG group had more contacts with the CRC, on average, than TRG members who had not worked there before (Table VII). But these ex-researchers are not as well connected with their divisional colleagues as the TRG members. On the other hand, the four ex-researchers who are in the TRG exhibit a lower degree of both internal and external communication than other TRG members as well as other non-TRG ex-researchers. However, since there are only four such individuals, no statistically significant conclusions can be drawn about this anomalous behavior.

Table VII

Attitudes of Members of the Technical Resource Group about the Corporate Research Center

	TRG Members who are also ex-researchers (n=4)	TRG Members who are not ex-researchers (n=28)	Comparison of TRG Members with and without Corporate Research Center experience	p *
Mean number of links within region	2.3	3.4	2.9	N.S.
Mean number of links with the Research Center	1.5	1.7	2.2	N.S.

* Kruskall-Wallis k sample test

Discussion and Conclusions

The major finding from this study is that only 38% of formally designated liaison agents actually perform as gatekeepers. This suggests that the boundary spanning role that is expected to be performed by such individuals is substantially unrealized in practice because most of them lack the high degree of internal and/or external communication that is needed to satisfy one important gatekeeper criterion, i.e. the presence of strong communication networks.

Our study shows that effective gatekeeping cannot be mandated just by assigning people to fill that role. Effective communication networks are formed over a period of time as formal and informal contacts are developed and cultivated. This process cannot be made to happen overnight to fulfill the charter of a designated boundary spanning role. Instead of nominating individuals, without the benefit of a careful selection process, to be gatekeepers, organizations would do better by selecting individuals already known to be effective gatekeepers to positions where their strengths can used to maximum advantage. The process of transfer can be greatly enhanced by giving such communication stars the responsibility, rewards and supporting budget to actively track and transfer technologies developed outside their organizational units.

However, if professionals with gatekeeper characteristics can not be readily found, formally assigned boundary spanning roles can still be made more effective by selecting people who have both high technical credibility and strong internal or external networks and by helping them cultivate the "missing" component via mechanisms (Allen, 1977) such as: transfers, rotation, and visits to technology source units; priority exposure to orientation programs; and design and location of physical facilities to promote greater internal communication.

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